Single Versus Segmental Maxillary Osteotomies and Long-Term Stability in Unilateral Cleft Lip and Palate Related Malocclusion

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Purpose: To investigate the stability of single-piece versus segmental (2-piece) maxillary advancement in patients with unilateral cleft lip and palate (UCLP) treated using conventional Le Fort I orthognathic surgery.

Patients and Methods: A retrospective study was undertaken in 30 patients with nonsyndromic UCLP treated with the same surgical and orthodontic protocol from 2002 through 2011. Standard lateral cephalometric radiographs were taken preoperatively, immediately postoperatively, and at least 1 year postoperatively. Patients were divided into single-piece and segmental Le Fort I groups based on planned surgical movement. Postoperative movements were compared between groups using repeated measures analysis of variance.

Results: The mean skeletal horizontal advancement was 7.3 and 7.5 mm in the single-piece and segmental groups, respectively. The skeletal horizontal relapse was 1.3 mm (18%) for the single-piece group and 1.9 mm (25%) for the segmental group. The skeletal surgical extrusion was 2.7 mm for the 2 groups. The skeletal vertical relapse was 0.6 mm (22%) and 1.5 mm (56%) for the single-piece and segmental groups, respectively. The mean dental horizontal postoperative movement was an advancement of 0.4 mm for the single-piece group and a relapse of 0.2 mm (3%) for the segmental group. The mean dental vertical relapse was 0.1 mm (4%) for the single-piece group and 0.3 mm (11%) for the segmental group. There was no statistically significant difference in relapse between the single-piece and segmental groups for all movements ($P > .05$).

Conclusion: Skeletal and dental relapse was similar between single-piece and segmental maxillary advancements using conventional Le Fort I orthognathic surgery in patients with UCLP.

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Segmental Le Fort I surgery is an integral tool in the management of occlusal and skeletal imbalances. Although it has been well investigated in the non-cleft literature, few studies have looked at the long-term stability of single versus segmental advancements in the cleft orthognathic surgical population. Moreover, studies investigating stability in cleft populations do not often look at a homogeneous group of patients with the same cleft phenotype managed with unified surgical and orthodontic treatment protocols. Posnick and Dagys[1] and Heliövaara et al[2] emphasized the importance of a homogenous cleft population in validating and comparing cleft orthognathic surgical studies.

Single-piece Le Fort I osteotomies allow control of the maxilla in sagittal, vertical, and rotatory positioning. Segmentation of the maxilla can enhance this control by addressing specific occlusal problems related to the cleft deformity. It can enable opening or closing of the cleft alveolar gap depending on the planned implant reconstruction, facilitate alveolar bone grafting, and close alveolar fistulas. It can widen the maxillary arch, allow differential movement of greater and lesser segments, align the occlusal plane, and maximize intercuspation to improve postoperative stability.

The primary objective of the present investigation was to look at and compare long-term stability of skeletal and dental outcomes in single-piece and segmental advancements using conventional Le Fort I orthognathic surgical procedures in patients with nonsyndromic unilateral cleft lip and palate (UCLP).

Patients and Methods

PATIENT SELECTION

A retrospective chart review was performed of all Le Fort I maxillary advancements in patients with UCLP at the Hospital for Sick Children (Toronto, Canada) from 2002 through 2011 and whose complete diagnostic records were available. The study was approved by the hospital's institutional review board. Patients were excluded for the following reasons: diagnosis other than complete UCLP; syndromic clefts; patients who previously underwent distraction osteogenesis; patients in whom initial cleft repair, orthodontics, or any other treatment was completed at another institution; patients who did not have secondary alveolar bone grafting (bone grafting at the time of the transitional dentition); patients who underwent orthognathic surgery with more than 2 maxillary segments; and patients without appropriate lateral cephalometric radiographs.

Patients were grouped according to the surgical procedure into single-piece or segmental (2-piece) Le Fort I maxillary advancement groups. All patients underwent Le Fort I advancement with plate fixation. All segmental osteotomies occurred through the cleft site in the alveolus. The segmental movement involved closure of the cleft alveolar gap or widening of the alveolar arch. All single-piece advancements did not require closure of the cleft alveolar space or widening of the alveolar arch. Fistula closure (if present) and bone grafting were performed simultaneously in segmental surgeries. All patients received bone grafts (27 from the iliac crest and 3 from the maxillary bone). Bone grafts were used at the Le Fort osteotomy site and the alveolar segment site. Cancellous bone was used primarily at the alveolar segment and a combination of cancellous and cortical bone was used at the Le Fort osteotomy site. Fixation of all patients was with 4- × 2-mm plates. No separate plates were used across the alveolar segments in segmental surgery. Preoperative and postoperative orthodontic treatment was undertaken in all patients. Occlusal splints were used intraoperatively and left in situ for 6 to 8 weeks with guiding elastics where required.

CEPHALOMETRIC ANALYSIS

Standard lateral cephalometric radiographs were taken for each patient immediately before surgery (T1), immediately (≤1 week) after surgery (T2), and at a minimum of 12 months after surgery (T3). At 12 months after surgery, the maxilla is considered stable.[3-5] One examiner traced all cephalograms with a digitizer connected to a computer using Dentofacial Planner 7.2 (Dentofacial Software, Toronto, Canada).[6] The change of maxillary position between time points was assessed using superimposition of the anatomic best fit of the anterior cranial base parallel to the line between the sella and the nasion (SN) based on the sella.[2] Preoperative tracings of the preoperative maxilla were superimposed on subsequent radiographs to assist in identification of anatomic landmarks.[5] To measure skeletal and dental horizontal and vertical changes in the maxilla over time, an x and y coordinate system was established (Fig 1).[1,2,7] The x axis was orientated along the SN and the y axis was orientated perpendicular to this line through the sella.[6,8] Horizontal changes were measured as a distance along the x axis to the anatomic point. Vertical changes were measured along the y axis to the anatomic point.[7] The skeletal anatomic point used for horizontal and vertical changes was the A point and the dental point was the mesiobuccal cusp of the upper first molar (left and right; Fig 1).[9] If the patient was diagnosed with a left-sided UCLP, then the left molar measurement was designated the lesser segment and the right the greater segment and vice versa. Averaging left and right molar measurements produced mean dental movements. Other cephalometric skeletal outcomes measured were the angle formed by the